Lightyear 

Lightyear

Welcome to a new dawn!

We are delighted to welcome you to Katwijk. We're going to witness and celebrate a special moment - the official unveiling of Lightyear One.

This day marks an important milestone in a journey that started in 2012. As the founders of Solar Team Eindhoven, we have believed in a solar-powered future for years. Our mission has always been to make clean mobility available to everyone, everywhere. The presentation of Lightyear One is a huge step towards realizing that mission.

This idea was sparked seven years ago and for the past two and a half, we've pushed electrical, mechanical, material and design philosophies past their boundaries to make the first long-range solar car. Our engineers have invented new solar cells and in-wheel engine technologies to create revolutionary range and efficiency. We also partnered with a legendary Italian design studio to ensure the appearance of Lightyear One is as world-class as its technology.

For us, this prototype launch feels like the starting point of a new era. In the next phase of our journey, we will continue to push boundaries to bring Lightyear One to the market and onto the road towards a sustainable future.

We hope this premiere inspires you to follow us in the exciting years to come. We are launching our own podcast series to keep our fans updated on our progress. It's a must-follow for learning about the future of driving as we see it.

We're happy you are here with us today to become part of our sustainable movement!

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Lightyear unveils the world's first long-range solar car

Prototype Lightyear One debuts in sunrise presentation

Katwijk, June 25, 2019 – Lightyear, a pioneer in clean mobility, introduced the first long-range solar car today. The prototype was presented to a select audience of investors, customers, partners and press at the break of dawn in the TheaterHangaar in Katwijk, the Netherlands. "This moment represents a new era of driving," said Lex Hoefsloot, CEO and co-founder of Lightyear. "Two years of dreaming, thinking and working hard have led to this milestone, which is a giant leap towards achieving our mission of making clean mobility available to everyone."

Lightyear was founded in 2016 by alumni of Solar Team Eindhoven, which won the Bridgestone World Solar Challenge in 2013, 2015 and 2017. Since the launch, Lightyear has received several awards, grants and support from key investors. "This allowed us to develop a working prototype for the first long-range solar car in just two years. We have already sold over a hundred vehicles. With Lightyear One, we want to show that our technology enabled us to build one of the most sustainable cars on the market, which also offers great convenience."

Lightyear One has been engineered from a radically different perspective. Hoefsloot elaborated, "We all have a performance background, and with that, we focus relentlessly on optimizing efficiency and safety." Lightyear started from scratch, following not convention but only the laws of physics to purposefully design a car that "gets the most out of every ray of sunshine". Hoefsloot continued, "The main goal of the car is to fill in where electric cars fall short. Research has shown that range and the lack of charging options are still the top concerns that people have when considering electric cars."

"We are solving these issues with what we call ultra-efficiency. On one hand, that will lead to an exceptional range of 725 km (WLTP) on a relatively small battery. On the other hand, it can charge directly from the sun because its energy consumption is much lower, generating up to 20,000 km worth of energy per year. Moreover, all of the charging options out there become easier to use because you get a lot more range for the same amount of energy charged. So, effectively, you charge a lot faster from any power outlet. You can charge up to 400 km per night from ordinary 230V sockets. That's great for road trips because you don't need a charging infrastructure."

- The car is constructed from high-tech materials to have the lowest weight possible while maintaining stringent passenger safety

- Lightyear One is propelled by four independently driven wheels, so no energy is lost in transit from the engine to the wheel

- The roof and hood are comprised of five square meters of integrated solar cells in safety glass so strong that a fully-grown adult can walk on them without causing dents

- In addition to solar power, Lightyear One can be charged at a (fast)charging station or even a regular outlet

During the presentation of the prototype, Lex Hoefsloot emphasized the importance of the moment. “Climate change is one of the biggest problems that we humans have faced in our history. It is such a frightening development that it is almost paralyzing. We decided to do the opposite; as engineers, we believed we could do something. Lightyear One represents a huge opportunity to change mobility for the better.” Hoefsloot stressed that nature has been a great source of inspiration. “For centuries, we have lived in balance with nature. With the technologies of today, we have the opportunity to do so again. By starting from scratch and using the laws of nature as a guideline, nature becomes our greatest ally in developing ultra-efficient designs.”

According to Hoefsloot, this is just the beginning. “Since new technology has a high unit cost, we have to start in an exclusive market; Lightyear One is the first long-range solar car and has staggering specifications. The next models we plan to develop will have a significantly lower purchase price. In addition, future models will be provided to autonomous and shared car fleets, so the purchase price can be divided amongst a large group of users. Combined with the low operating costs of the vehicle, we aim to provide premium mobility for a low price per kilometer. A third, final step will be to provide truly sustainable cars that are more affordable to use than the cost of gas you need to drive a combustion car. This will prove to be our most important tipping point in the near future, and it will pave the way for a car fleet that is one hundred percent sustainable.”

Availability

Lightyear will be ramping up production of the Lightyear One in 2021. The first 100 cars have already been reserved. Via the Lightyear website, buyers can now reserve one of the 500 Lightyear Ones for a reservation fee of €119,000 (expected delivery in 2021).

About Lightyear

Lightyear's mission is to make clean mobility available to everyone, everywhere. Lightyear develops electric cars with energy-efficient design and integrated solar cells. Drivers could go up to 20,000 kilometers a year on the sun, depending on the climate. The fast-growing company was founded in 2016 and now has more than 100 employees. The team is a mix of young talent and experience from the automotive industry, including former employees of Tesla and Ferrari. Lightyear also opened its own production facility in Helmond. In less than two years, the company has raised over 20 million euros from reservations, investments and grants. They were awarded CES Climate Change Innovator, Postcode Lottery Green Challenge Finalist, and, recently, Lightyear received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 848620. In the summer of 2019, Lightyear will open a new office and launch the first prototype of the Lightyear One, Lightyear's first model. www.lightyear.one

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Are electric cars really reducing CO^2 emissions?

By: Henk de Bruin, Sustainably advisor

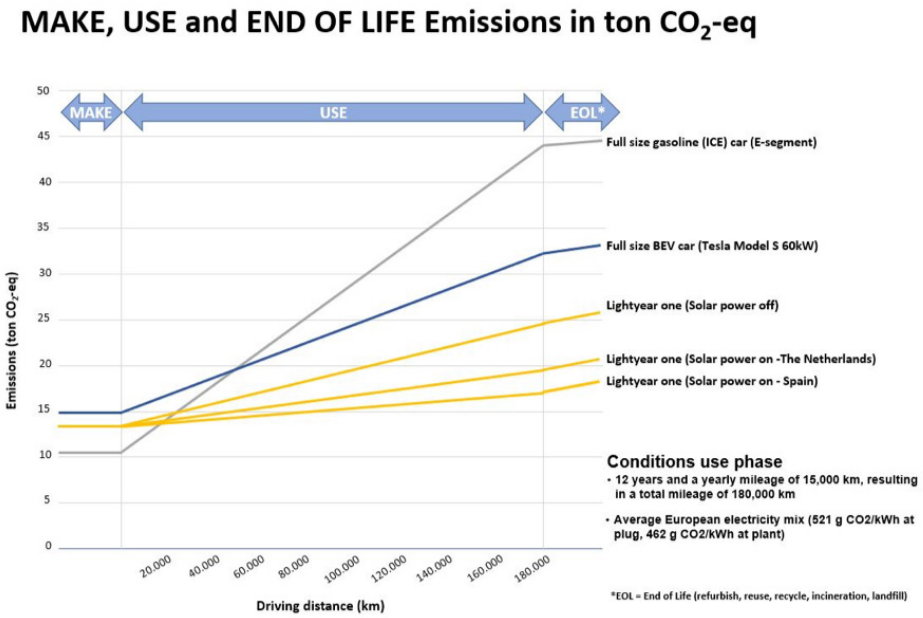
As Global Head of Sustainability in a large multinational I have been working on a road range of topics for many years. I helped define the sustainability elements are relevant for the company and in which parts of the value chain those elements need to be addressed. I then followed up by measuring the company's performance on said elements and identifying possible improvements and worked on in- and external reporting.

Within Lightyear, I am applying that experience in the challenging environment of a fast-growing company focused on contributing to a sustainable society with its products and services. The three subjects I will discuss are: Carbon Footprint, Circular Economy and Supplier Sustainability.

Carbon Footprint

In our efforts to support the reduction of global warming, the benefit of an electric vehicle with no tailpipe emissions is clear. That benefit is enlarged substantially if such a car is solar driven because additional charging from the grid can be limited to none, depending on geography.

Indirect CO2 emissions of electric power plants supplying grid charging can be low or even zero when coming from renewable sources. Carbon emissions, however, also occur during the making of a car and at the end-of-life of a vehicle. At Lightyear, we are building up our insight of the total carbon footprint of the car in order to guide our efforts to optimize the carbon footprint over the life cycle of the car. In the illustration on the next page, a high-level comparison with literature data of a comparable gasoline car, a Battery Electric Vehicle (BEV) and the Lightyear One.



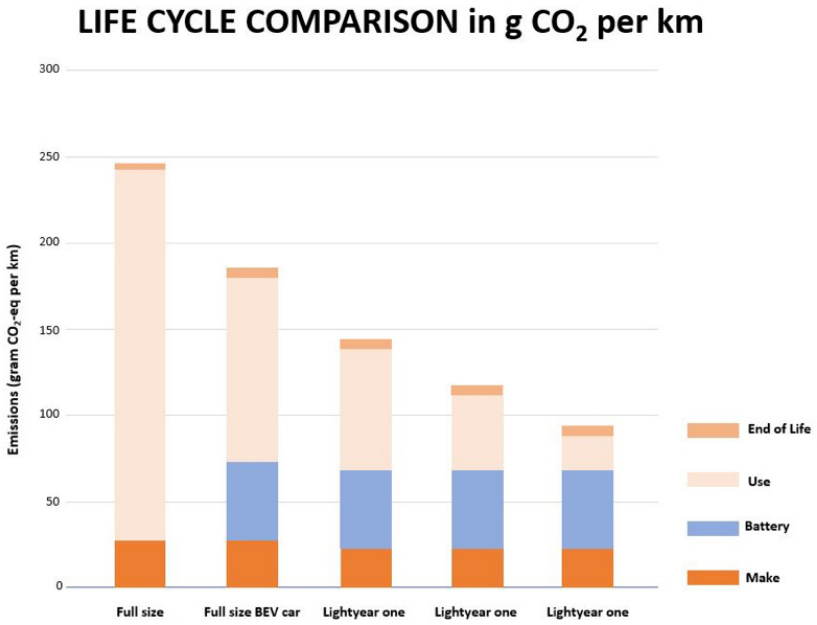
This graph shows estimations of the production, use and end of life (EOL) amounts in tons of CO2-eq for different types of cars.

All three phases of the life cycle of any vehicle contribute to CO2 emissions, but the use phase is the largest.

Indirect emissions of a Battery Electric Vehicle in the use phase are, on average, lower than gasoline cars, depending on the electricity mix (generation by coal, gas, oil, nuclear, renewables) of power plants.

In the graph above, the average European electricity mix is used, and the line of a gasoline car and a Battery Electric Vehicle cross each other between 40.000 – 60.000 km. If electricity is only generated by coal, the use phase part of the graph for a Battery Electric Vehicle is steeper and the crossing point with the line of a gasoline car goes farther to the right. When making comparisons, taking the electricity mix used into account is therefore always relevant.

Lowering the carbon footprint in the use phase for a Battery Electric Vehicle can be realized by changes in the electricity mix towards more renewables. The Lightyear One stands out in CO2 reduction during use because it has its own individual solar cells on board all the time and only needs limited charging from the grid.

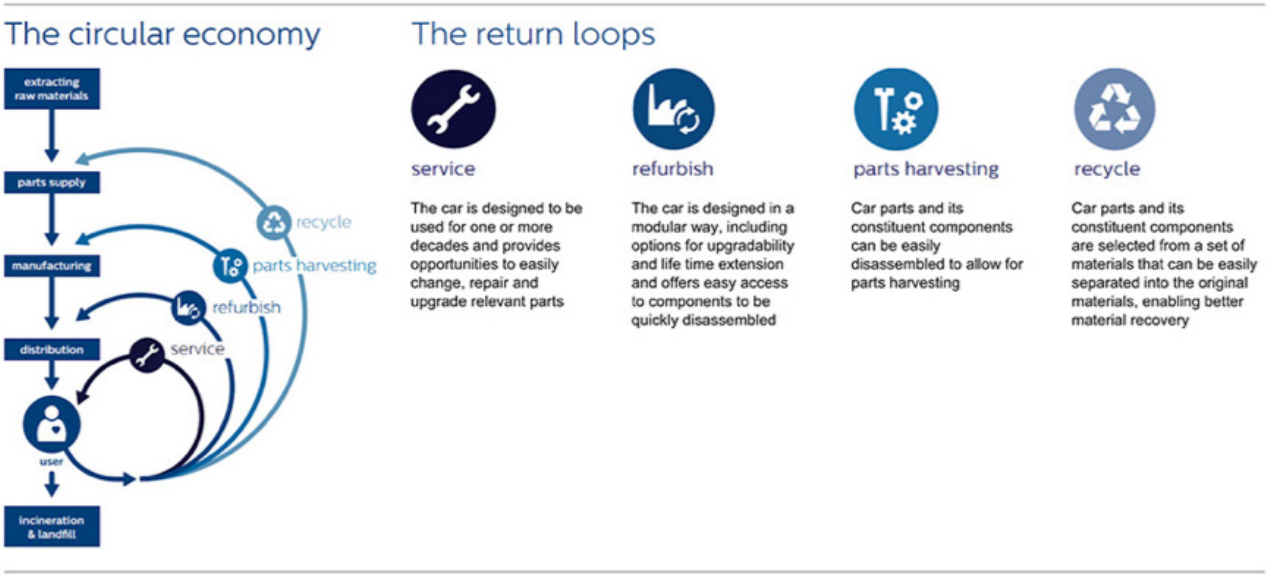


In the graph above, the same estimations and conditions are expressed in grams CO2 per kilometer.

Compared to a gasoline car, an electric vehicle has a larger carbon footprint in the production and end-of-life phase caused by the production respectively recycling of the battery pack. The Lightyear One has a slightly lower carbon footprint in production because of our car's optimized efficiency by which we can utilize a relatively small battery pack while still providing a broader range.

Circular Economy

At Lightyear, we see the transition from a linear to a circular economy as a necessary and complementary boundary condition. A circular economy aims to decouple economic growth from the use of natural resources and ecosystems by using those resources more effectively. Moreover, it is a driver for innovation in the areas of materials, component- and product reuse, as well as new business models such as solutions and services as illustrated below.



This image shows how Lightyear approaches the choice of materials, designing the parts, assembly of the car and the development of business models.

In a circular economy, the more effective use of materials enables us to create more value, both by cost savings and by developing new markets or growing existing ones.

Within Lightyear in our approach for the choice of materials, designing of parts, assembly of the car and the development of business models, we are in the process of incorporating the Circular Economy principles in our way of working.

Supplier Sustainability

Long-term strategic supplier relationships are important to bring our innovations to market. We aim to share with our suppliers a common goal of continuous improvement and operational excellence. At the same time, we expect our suppliers to meet the proper standards in terms of quality, ethics and sustainability and support driving improvements in social and environmental performance in our supply chain. Tools that have been developed aiming to cover that process are, amongst others, the assessment of supplier sustainability performance, management of regulated substances, conflict minerals and, in due course, circular procurement.

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Designing Lightyear One: In-wheel motors

By: Wiebe Janssen — Powertrain Engineer

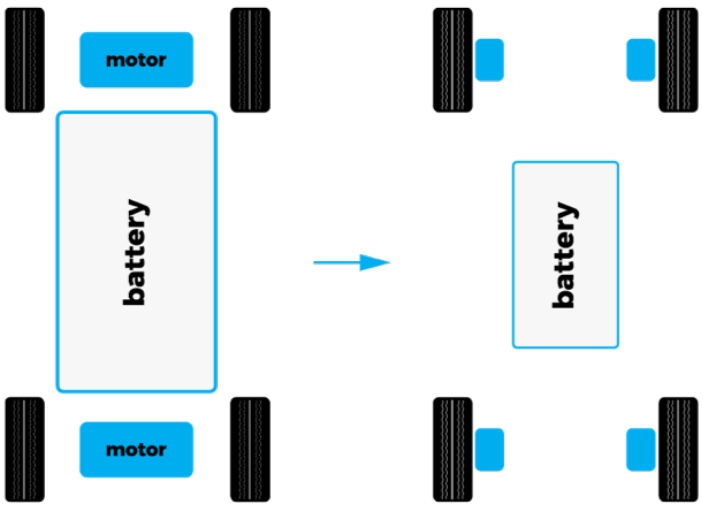
In the process of designing a car, choosing the right motor is very important. I would like to give a look into this process by explaining what we look for in motors and how we approach this search for the best possible match for the Lightyear One.

‘Why using motors within the wheels rather than elsewhere’

A very important reason to use in-wheel motors, is to optimize the Lightyear One for efficiency to make it a success as a commercial solar car. To do so we looked at existing innovations, as well as what direction we wanted to take the Lightyear One. In-wheel motors offer a solution. By elimination of the transmission we minimize needless energy loss. Moreover, the car becomes lighter, and a lighter car requires less energy.

We want to make owning a Lightyear One a true pleasure to use, also on the long run. One component of doing so is reducing the cost of ownership for the Lightyear One. By reducing the amount of maintenance needed, the car becomes cheaper over it’s lifecycle. The best way to achieve this is by keeping the systems as simple as possible. In-wheel motors drastically reduce the amount of moving parts in the car and with that the need for maintenance.

Another convenience of using in-wheel motors is the extra space. By using small distributed motors a lot of space is freed up within the car.



Visual representation of the extra space available when having an in-wheel motor

Last but not least, independence is a core goal for our car. We want the car to be independent from the grid but also the road network the user choose to drive. To enable driving off-road you need individual and precise control over each wheel individually. The complete drivetrain will allow for this. All these factors combined made in-wheel motors the ideal choice to make Lightyear One a success as the first long-range solar car.

‘The process of picking the perfect motor for the Lightyear One’

You cannot just arbitrarily pick one motor configuration or design, place it in all four wheels and be done with it. We have to carefully go through the process from requirement definition, system design and concept evaluation. Next to that, partnerships throughout designs, development, manufacturing, prototyping and testing have to be established. We want to find the best possible match.

The right configuration will lead to the desired performance. This technology has an enormous potential. Because we are developing a novel powertrain platform we are not just creating new possibilities for the Lightyear One, but also for the models to come. The choices we make in this stage will affect the ones for the years to come. As such we have stringent requirements for efficiency, weight and torque.

Designing Lightyear One: Aerodynamics

By: Annemiek Koers — Aerodynamics Engineer

With aerodynamics we study how well the air flows around the car. Our job at the Aerodynamics team is to ensure that the air will move along the curves of the car as smoothly as possible. Because we stop the air from moving in swirls, into holes or into interstices, we reduce friction between the car and the air. We want the car to cut through the air just like a raindrop – the ultimate example of an aerodynamic object.

So now the question is: Why does this matter? Since we do not have an infinite surface for our solar panels there is only a certain amount of energy available to the car, especially if you want to drive on solar energy only. We want to use the energy that is available as efficiently as possible. To do so the car needs to glide through the air: we want low air resistance. We want to give you the longest possible solar range. The less energy the car wastes moving air, the further the car can get on the same energy. For this reason, aerodynamics is one of our key focus points. This focus sets us apart from other car manufacturers.

The most striking example of our focus on aerodynamics is found in the way we the design the exterior of the car. For the exterior shape of the car we work together with an Italian design company. There is a strong interaction between their aesthetic design and what shapes we prefer in terms of the aerodynamics. The connection between the design company and what we aim to create in the aerodynamics team is immense. By working together, we can finetune the Lightyear One into the ultimate aerodynamic car. I believe we excel at this in respect to other car manufacturers. To us the aerodynamic design goes hand in hand with the aesthetic design. Other companies often place much more emphasis on the looks alone.

“To us the aerodynamic design goes hand in hand with the aesthetic design”

My passion for aerodynamics has been long standing. After my bachelor studies in Aerospace Engineering I joined the solar team of Delft University as an aerodynamics engineer. Over the course this project I got to know the founders of Lightyear as our colleagues from the first solar team of Eindhoven University. Both our teams became world champions of the World Solar Challenge. Moving on after this experience, I continued my studies and got a masters degree in Aerodynamics. My love for aerodynamics also shows in my passion for glider planes. Glider planes can have a range of over 600 km per flight without an internal motor! The car industry has always interested me because new ideas can be used in development quickly, and with the sustainable vision of Lightyear I am excited to contribute to the future of transportation.

We are still improving the outer shape of the car to reduce resistance. I love this creative process. It is a constant challenge, always looking for things that will lower the air resistance even further so we get closer to our ultimate resistance goal. Right now the Cd is estimated to be below 0.20, well below the current market leaders, but we are always looking to create an even lower number. The Cd is the 'Coefficient of the Drag Area', that is the resistance coefficient of the car times the frontal surface. It is a value used to indicate the aerodynamic performance of the car.

Designing the Lightyear One is special. The nice thing about my work at Lightyear is how I am given the freedom chase an ever-lower value. The interaction with the other modules makes my job especially interesting: "Okay, I've come up with this idea and it will help with the aerodynamics this much, how does this influence you? Can we apply this idea, or does it cost in aerodynamics on your side? " In my job I get to unite the practical and the beautiful, sexy part of the car.

I am especially proud to be part of the team, of how we present ourselves to the rest of the world. I also love the reactions that I get from people when I tell them where I work and what I do. In addition, the first wind tunnel test was quite a highlight for me. We simulate many of our aerodynamic designs in software programs before testing them in real life, but putting our design to test in a windtunnel is different. I personally prefer the experimental side and putting ideas to the test in practice.

Check out this short Q&A during the first windtunnel test.

Designing Lightyear One: The solar roof

By: Simone Regondi — PV Engineer

At Lightyear, we all appreciate the unique value of Lightyear One's solar roof; it is a direct clean energy source and a core technology we are developing. As a photovoltaics engineer I am working on integrating the solar cells, both electrically and mechanically. Currently, we are mainly focusing on process optimization, improving technology maturity level and bringing parts to manufacturing quality.

Check out this video to learn about the testing of the solar roof.

The 3 main elements of Lightyear One's solar roof

Lightyear One's solar roof is composed of 3 main elements. The top layer, made of glass. It protects the solar cells while letting light in, and gives a smooth surface to the roof. The second layer is the photovoltaic (PV) module containing the solar cells. This module is laminated together with the third element: the supporting structure. The solar roof has a unique curvature in order to maximize the aesthetics and aerodynamic performance of Lightyear One. To create the right strength and optimize the weight of the roof, the supporting structure and the method used in the glue process are being developed in-house.

This last part – keeping the PV module lightweight while making it sturdy – is also one of the most challenging aspects. We are working with different partners such as TNO to ensure that the product is safe and reliable. In order to test the mechanical properties, we performed a ball drop test and different static load cases. We also conduct thermal tests to address the suitability of the bill of materials (a list of raw materials), as well as take measurements for electrical performance

Aesthetics of the solar cells are very important for Lightyear One. On the left you see a design prototype of the solar roof. On the right, you see a functional prototype where we left out the steps that enhance the aesthetics. The difference is clearly visible.

Good looking and efficient

We designed the roof to be slightly curvy for aerodynamic and aesthetic reasons, while maintaining focus on surface optimization. What is great about the rear-contact crystalline silicon cells we use, is that we can increase the power conversion efficiency. This also eliminates the metal busbars on top of the cells, improving the aesthetics of the roof. We are still innovating in applying conductive back-sheet technology to vehicle-integrated photovoltaics and this brings huge advantages. We can develop a system for a completely automated photovoltaic module fabrication, and we have extreme flexibility in deciding cell size, location and orientation.

The solar area

In the Netherlands the solar area of Lightyear One can deliver a peak power of around 1250 Wp and can provide about 700 kWh per year. This translates, for example, into a ski trip from Amsterdam to Innsbruck (1802 km back & forth) in which you only have to charge the car twice. Predicting the energy yield is always a challenge for vehicle-integrated photovoltaics because of the changing environment. This includes weather conditions, time of year and location. The model used for the calculator on our website includes a lot of different sources for this combined with a loss factor due to shadow.

Currently, we are working on validating this model. We have developed devices to collect solar irradiance data and put them on different test cars so we can calculate the energy yield as well as the losses due to shadow on the car. Based on all the collected input combined with our calculations and simulations, Lightyear One is expected to generate around 50-70 km extra range per day, during a Dutch summer. Due to all this energy however, the solar cells can get warmer in certain conditions. Normally when you have a PV structure on your roof you receive 1x the sun's energy. When your car is parked next to a reflective building however, the car can be exposed up to 1.5x the energy. Together with the Energy Research Centre (ECN) at TNO, we conducted tests to determine the reliability of the solar panels at elevated temperatures. The test was based on the car receiving twice the normal amount of energy, and the structure successfully passed.

After all this, you might still wonder how far you will get with 1 hour of sunshine on an empty battery. Imagine yourself driving through the blooming Dutch countryside at around noon, with sunny weather and barely any traffic. You will have 15 km to get to any power outlet in order to start charging at the same speed (km/hr) a normal EV would do at a special charging station.

Designing Lightyear One: Design

By: Koen van Ham — Chief Design and Cofounder Lightyear

We wanted people to fall in love with Lightyear One at first sight. We wanted a form that people would recognize as world class, but that also displays what sets Lightyear One apart. It should be familiar, but point to the future we believe in, one in which automotive design balances on efficiency. Our main goal wasn't technological, though there were engineering challenges we knew we'd have to solve. Our goal was and is to change how people relate to electric vehicles.

People-centered design

We did that by putting people at the center of the design process. We worked iteratively with potential customers. It started in June 2017, when we released a teaser focused on design. It got a huge response, which allowed us to invite interested people to our headquarters. Our discussions with them helped us hone in on what consumers truly need and want from their car. We learned what they liked and found key aspects of our solar car design. We were able to iterate by using virtual reality to create digital mockups and gather feedback. This technology allowed us to increase iterations and speed while incorporating time for reflection into the design process.

Freedom of the road

The appeal of the car is the freedom that it offers, the primal call of the open road. We started thinking about what else our car could do to free its owner. Could we translate the carefree feeling of skipping lone highway charging stations into the whole experience of the car? That led us to another way of thinking about Lightyear One: as a mobile energy source. We started thinking about how valuable that could be on adventures, which prompted us to design a way for appliances to plug into the car. Suddenly, new possibilities for off-grid adventures opened up. At Lightyear, we like to encourage this kind of creative thinking, in ourselves and our drivers.

A pioneering look

Exterior design is crucial to how people relate to their car. It should encourage people to go anywhere and return from their adventures stress-free. Our initial image was the freedom of sailing and the solidity of a sturdy car in nature. You can see it in the exterior of Lightyear One. It has a super-efficient upper body with a robust lower half. Most importantly, it captures the eye and uses that moment of attention to inspire the viewer with possibilities.

Minimalistic design

We aimed for a timeless, minimalistic approach. The car will have minimal impact on the environment and the design emphasizes this. It doesn't scream for attention, but radiates a true beauty that will become iconic. We created it in collaboration with Lowie Vermeersch and his company, Granstudio. They have been designing supercars for decades and were excited to design the next step in clean mobility.

The team made up of Granstudio designers and our engineers started by setting exterior design goals. This was crucial because it set the standards for the final outcome. These objectives were: a large area for solar cells, low rolling resistance, low aerodynamic resistance, reduced weight and an aesthetically pleasing appearance. It's important to find the right balance of ingredients to create a high-performance vehicle with a striking aesthetic.

Challenges to solve

In the beginning, there were obstacles to designing an aesthetically pleasing solar car. One of the most critical was creating a double-curved solar roof, which hadn't been done. We were also concerned with how solar cells look on the car roof. They had a huge impact on the car's appearance, so we set out to produce a solution for both. Thanks to our engineering team, we have not only been able to create a double-curved solar roof but to cover it with beautiful strengthened glass. It makes the cells underneath look like futuristic space-age technology. It's the perfect example of efficient engineering being the single answer to a problem that is both technical and aesthetic.

This is one of my favorite aspects of Lightyear One: meaningful technology made beautiful by great design.